(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 443 616 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
16.09.1998 Bulletin 1998/38

(51) Int Cl.[6]: **G03G 5/05**

(21) Application number: **91102648.2**

(22) Date of filing: **22.02.1991**

(54) Process for forming multilayer coating

Verfahren zur Herstellung mehrschichtiger Beschichtungen

Procédé de revêtement multicouche

(84) Designated Contracting States:
DE NL

(30) Priority: **23.02.1990 JP 41135/90**
14.06.1990 JP 153861/90

(43) Date of publication of application:
28.08.1991 Bulletin 1991/35

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- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 59 (P-826)(3407) 10 February 1989, & JP-A-63 249 148 (TOYO INK MFG CO.,LTD.) 17 October 1988**

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Description

FIELD OF THE INVENTION

The present invention relates to a process for forming a multilayer coating. The process enables coating of multiple layers by a continuous process in which mixing and diffusion between the layers is prevented. The process is particularly useful for producing, e.g., electrophotographic photoreceptors or photosensitive printing plate precursors comprising two or more coating layers.

BACKGROUND OF THE INVENTION

It is known to provide a multilayer coating film comprised of an aqueous coating composition by a method in which, e.g., multiple layers of a silver halide emulsion having gelatin as a binder are simultaneously applied on a continuously moving support by means of a slide hopper type coater or an extrusion hopper type coater. Immediately after coating, the multilayers are coagulated in a cooling zone utilizing the sol to gel change phenomenon of a hydrophilic colloid such as gelatin so that the viscosity of the multilayers becomes extremely high, e.g., in the range of from 10 to 100 Pa·s (1×10^4 to 1×10^5 centipoise (cP)). In this state, the layers hardly mix with each other. Thereafter, the temperature of the system is gradually raised to bring about drying of the multilayers, usually with hot air to facilitate evaporation of the solvent or the like. The result is a coating film comprised of multiple layers.

On the other hand, in the case where an organic type coating composition (a composition containing an organic solvent) is merely applied in multilayers and then dried, diffusion and/or mixing is apt to occur in the bead portion being coated and in the freshly coated multilayers between the time of application and the time of drying. Diffusion and/or mixing also is apt to occur in between the coated layers and the underlayers since the surface tension of organic coating compositions is low compared to the surface tension of an aqueous type coating composition, and further, since there is no sol to gel conversion step, diffusion/mixing is liable to occur during the step of drying.
That is, in a coating composition comprising an organic solvent, there are no sol to gel type conversion materials having compatibility with a broad range of ingredients which can be used in the organic solvent the way in which gelatin can be used in an aqueous solvent.

Accordingly, it is very difficult to obtain a coating film in a state in which layers thereof remain fully discriminated from each other, particularly in the case of using an organic type coating composition.

For the foregoing reasons, in the case of forming a multilayer coating film comprising an organic solvent, a method in which layers are successively applied and dried one after another has been generally used. As such a successive application and drying system, there are known methods in which layers are sequentially applied and dried, methods in which a plurality of application and drying portions are provided so that application and drying are continuously performed, and so on. In the former method, however, an extremely long manufacturing time is involved so that the manufacturing cost becomes extremely large. In the latter method, on the other hand, the number of application and drying stages corresponds to the number of layers, so that the provision of extremely expensive manufacturing equipment is required and the manufacturing cost becomes extremely large.

As described above, various methods for obtaining a multilayer coating film have been proposed until now. Of those methods, the method in which a coating film is applied and dried layer by layer requires an extremely large-scaled equipment. The methods in which a bead is formed by a multilayer slide die or in which a curtain film is formed by a multilayer die so as to form a simultaneously multilayer coated film are not effectively used for the coating of a composition comprising an organic solvent, although the method can be effectively used for coating a composition such as a photosensitive material or the like by taking advantage of the sol to gel conversion.

The present inventors have made investigations in order to solve problems as described above, and have discovered a process for forming a multilayer coating film which is disclosed in Japanese Patent Publication No. Sho-62-51670. In this method, an electron-beam hardenable resin is added to a non-aqueous coating composition (a coating composition comprising an organic solvent). Thereby, it becomes possible to realize formation of a multilayer film continuously by multilayer application of a coating composition comprising a non-aqueous solution, a result which has been very difficult to obtain by the conventional methods. The method, however, has the technical limitation that resin to be hardened by electron beams must be contained in the coating composition, thus the coating composition is increased in viscosity, and so on.

In the art of making photosensitive printing plate precursors, most photosensitive printing plate precursors have been of the single layer type and have been produced by a method such as wheeler coating, roll coating, bar coating, bead coating, or the like.

On the other hand, various photosensitive printing plate precursors having a multilayer configuration have been disclosed, for example, in JP-B-53-36364, JP-B-50-7481, (the term "JP-B" as used herein means an "examined Japanese patent publication") JP-A-50-133008 (the term "JP-A" as used herein means an "unexamined Japanese patent

publication"), DAS 1,671,626, and the like. In producing such printing plate precursors, methods such as wheeler coating, roll coating, gravure bar coating, bead coating, or the like have been used so that a lower layer is first applied and dried, and then an upper layer is applied and dried to thereby produce a photosensitive printing plate precursor having multilayers.

However, these methods of making a multilayer photosensitive printing plate precursor are deficient in the following points. That is, in the process for wheeler coating, there was a problem in that since a thick film is spread by a centrifugal force, a lower layer is apt to be dissolved in the upper layer liquid in the spreading step particularly in the case where the kind of solvent in the upper layer is the same as that in the lower layer, and therefore it is difficult to obtain a film having a configuration in which upper and lower layers remain fully separated from each other.

On the other hand, in the process for roll coating, gravure coating, bar coating, or the like, there is a problem in that since coating is performed by bringing a coating roll, a gravure roll, a bar, or the like, into contact with an already-coated film surface, there is a possibility that when coating of the upper and lower layers is performed with the same group solvent, a lower layer surface is dissolved by the solvent in the upper coating layer. In an extreme case, the underlayer may even be physically damaged. The range of suitability of this type of coating is therefore extremely limited. Further, in the process for bead coating an upper layer onto an underlayer, when the same type of solvent is used for the upper and lower layers (i.e., hydrophobic or hydrophilic), the lower layer is inevitably swelled or dissolved in between coating and drying. Therefore, even this method was not always satisfactory.

Conventionally, attempts to form a coating film with maintenance of separation between multilayers have involved using solvents for the respective layers which are hardly mutually dissolved, and it has been difficult to form a multilayer film using solvents capable of being mutually dissolved and by means of roll coating, gravure coating, bar coating, bead coating, or the like.

DE-A-971564 discloses a process for forming layers on a substrate by electrostatically depositing an atomized coating composition.

DE-A-2658839 discloses a process for successively forming a multilayer coating film on a substrate.

JP-A-63-249148 discloses a process for manufacturing a thin uniform photoconductor film by applying electrostatic charge to aerosol generated from a solvent dispersing or dissolving the photoconductor, and bringing it electrostatically into contact with the surface of a conductive substrate.

SUMMARY OF THE INVENTION

An object of the present invention is to solve the foregoing problems in the prior art and to provide a process for forming a multilayer coating film at a low cost without having any significant limitations with respect to the materials to be coated and in which coating compositions of both the aqueous solution type and the organic solvent type can be used.

A further object of the present invention is to provide a coating process by which high-quality multilayer photosensitive printing plate precursors or electrostatic photoreceptors can be simply and economically produced, and in which the foregoing problems in the prior art, that is, interlayer mixing generated in production of photosensitive multilayer printing plate precursors, can be extremely reduced.

The foregoing objects of the present invention can be attained by a process for forming a multilayer structure on a photosensitive printing plate, said process comprising the steps of:

(a) atomizing a first coating composition;
(b) passing said first coating composition with a carrier gas through a transport tube to a supply nozzle such that those particles of the first coating composition having a diameter of more than 50 μm are eliminated before they reach the supply nozzle;
(c) electrostatically charging the first coating composition having a viscosity of from 0.005 to 0.1 Pa·s (5 cp to 100 cp);
(d) electrostatically adhering the first coating composition on a moving support to form a first coating layer thereon;
(e) partially drying the first coating layer so that the viscosity of the first coating layer is 0.1 Pa·s (100 cp) or more; and
(f) repeating steps (a) through (d) to form a second coating layer on the surface of said first coating layer.

In the multilayer coating film formed by the foregoing method, no diffusion or mixing is caused between the first and second coating film layers even in the state where the layers are not yet perfectly dried. That is, according to the present invention, the process for producing a photosensitive printing plate precursor by applying a plurality of layers of a photosensitive coating component on a support is characterized in that after the formation of a prescribed layer, particles of a photosensitive coating component are made to successively electrostatically adhere on the prescribed layer to thereby form the next photosensitive coating film layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing the vicinity of the supply opening.

Fig. 2, diagrams (a), (b), (c) and (d) are schematic sectional views showing the steps of forming a paint film of two layers or more.

Fig. 3, diagrams (a), (b), and (c) are plans showing examples of the supply opening discharge outlet section.

Figs. 4 and 5 are schematic sectional views showing the steps of forming a coating layer.

Fig. 6 is a view showing data of the example.

DETAILED DESCRIPTION OF THE INVENTION

Atomized particles of a coating composition can be obtained by various atomizing apparatus such as a rotary bell, a spray nozzle, an ultrasonic atomizing apparatus, or the like. Charged particles of an atomized coating composition are obtained in such a manner that a coating composition is atomized in advance and then charged. Such apparatuses are well-known and reference can be made to, e.g., Kirk-Othmer, Encyclopedia of Chemical Technology, Volume 6, pages 417-419.

The present invention concerns the provision of a second or subsequent coating layer onto a first or immediately underlying coating layer. Any number of layers can be formed by the process of the present invention. For purposes of brevity, the first or immediately underlying coating layer will hereafter be referred to as the "first" coating layer, and the second or subsequent coating layer coated on the immediately underlying coated layer will be referred to as the "second" coating layer. The first coating film layer is formed through a process in which a coating composition is atomized in advance and then charged to thereby obtain charged particles of an atomized coating composition, and the particles of the coating composition are made to electrostatically adhere onto a body to be coated. The second coating layer is formed on the first coating layer.

The second coating layer is formed by electrostatically adhering charged particles of an atomized coating composition onto the first coating film layer, and it is important that the first layer onto which charged particles of an atomized coating composition are to be adhered has not yet dried before coating of the second layer. The viscosity of the first layer, at the time of coating the second layer, is 0.1 Pa·s (100 cP) or more, and more preferably several hundred cP or more.

The second coating film layer is formed through a process in which the coating composition is atomized in advance and then charged to thereby obtain charged particles of an atomized coating composition, and the particles of the coating composition are then made to adhere electrostatically onto the surface of the first coating film layer. Further (i. e. a third, a fourth, etc.) layers may be provided in the same way.

A preferred embodiment of the present invention will be described with reference to the accompanying drawings.

The positioning of the supply opening with respect to the body to be coated can be seen in Fig. 1.

The steps in which a coating composition is atomized in advance and then charged so as to obtain charged particles of an atomized coating composition, and the charged particles of the atomized coating composition are then made to adhere electrostatically to a surface to be coated thereby forming a coating film layer, can be seen in Figs. 4 and 5. That is, a coating composition is atomized in an atomizing room 12 by an ultrasonic atomizing machine 16 or an atomizing apparatus 11 such as a rotary bell, a spray nozzle, or the like, to thereby obtain particles of an atomized coating composition. The particles of the coating composition are carried by a carrier gas 17 from the atomizing room through a transport tube 5 to a nozzle or supply opening 4. Of the particles of the coating component, those having a large diameter collide against the respective wall surfaces of the atomizing room 12 and the transport tube 5 so as to be eliminated before the particles reach the supply opening 4. The viscosity of the particles is increased during travel because of evaporation of a solvent in the particles on the way to the supply opening 4.

The discharge outlet of the nozzle has an electrode 7, by which the particles of atomized coating composition are charged so as to be electrified and the charged particles, in laminar state, are made to electrostatically adhere onto the body to be coated so as to form a coating film layer. The sectional shape of the discharge outlet of the nozzle is not strictly limited, so that it may be a rectangle as shown in diagram (a) of Fig. 3, or may be a rectangle with its short sides rounded as shown in the diagram (b) of Fig. 3, or further may be an elongated ellipsoid as shown in diagram (c) of Fig. 3.

As the electrode 7, the type which extends linearly along the long side of the rectangle and slightly enters the inside of the rectangle section and which has one terminal outside the rectangle is preferably used. However, the shape of the electrode is not limited to this. The other terminal of the electrode is connected to a high-voltage generator through an electrode cable 6 so that a voltage from several to several tens kilovolts is applied to the terminal.

Support 1 is running while being guided by path rollers 2 and 3. The particles of the coating composition which have reached the nozzle discharge outlet are made to adhere electrostatically onto a body 1 to be coated so that a coating film layer uniform in thickness can be formed on the body to be coated.

The desired condition of the coating immediately after spraying is a smooth wet film with some leveling characteristics. The coating composition is actually applied as tiny droplets which flow upon impact with the surface. If the droplets do not contain enough solvent, they cannot flow and level properly, and uneven films may result. When too much solvent is used, a thin coating, which has a high incidence of defects, may be obtained. The amount of solvent to be used may vary widely and is easily adjusted depending on the material to be coated, the characteristics of the solvent selected, the coating conditions, the substrate, etc.

Diagrams (a), (b) and (c) of Fig. 2 are schematic sectional views wherein the above steps of forming a paint film are adapted to forming two layers or more. In Fig. 2, each of supply openings 4a, 4b, and 4c is the same as the supply opening 4 shown in Fig. 4., 6 represents an electrode cable, 7a, 7b and 7c represent electrodes, 8, 9 and 10 represent drying zones, 11 represents a belt, and 12 represents a sheet-like body to be coated. And diagram (d) of Fig. 2 is a schematic sectional view of an extrusion coater 18 and a drying zone 10. In this diagram, 19 represents a back-up roller.

First, the process illustrated in diagram (a) of Fig. 2 will be described.

Support 1 is running while being guided by path rollers 2 and 3. A first layer is formed on the surface of the support by a roll coater 18, and slightly dried in a drying zone 8. Next, a second coating film layer is formed on the surface of the first layer by means of the supply opening 4a, and slightly dried in a drying zone 9. Then, a third coating film layer is formed on the surface of the second layer by means of the supply opening 4b, and finally dried in a drying zone 10.

Slight drying means that the film surface is brought into a sufficiently dried state as necessary for the prevention of layer mixing in the drying zones 8 and 9 prior to the subsequent coating steps. For the prevention of mixing, it is usually sufficient if the first and second layers are not fully dried, but the film surface viscosity is increased to at least 0.1 Pa·s (100 cP) or preferably several hundred cP. The residual solvent can be removed as necessary in drying zone 10. Therefore, assuming that the same quantity of coating is applied by the respective coating steps, the length of residency in each of drying zones 8 and 9 can be considerably reduced in comparison with drying zone 10.

It is possible to suitably select the degree of drying of each of the layers in accordance with the desired degree of layer separation. In order to improve the degree of layer separation, it is also desirable to control the diameter and viscosity of liquid drops blown out of supply openings 4a, 4b, 4c, or the like, so as to adhere on the film surface. That is, if the diameter of the liquid drops is too large, the film surface of a lower layer is apt to be dissolved, and therefore it is necessary to select the maximum value of the liquid drop diameter so as to be about 50 μm.

Similar to this, if the viscosity of the liquid drops is too low, an increase in mixing with a lower layer is apt to be caused, and therefore it is desirable to select a viscosity so as not to be lower than 0.005 Pa·s (5 cP). If the viscosity is too high, that is, not lower than 0.1 Pa·s (100 cP), on the contrary, it is difficult to form a multilayer film because a film is hardly made smooth. When a lower layer or layers are not perfectly dried in the case of the application of two or more layers, however, there is sometimes a case where a film is smoothly spread even if the viscosity is not lower than 0.1 Pa·s (100 cP).

Next, the process shown in diagram (b) of Fig. 2 will be explained.

Support 1 is running while being guided by a path roller 2. A first coating film layer is formed on the surface of the support by supply opening 4a, and slightly dried in drying zone 8. A second coating film layer is formed on the surface of the first layer by supply opening 4b, and slightly dried in drying zone 9. Further, a third coating film layer is formed on the surface of the second layer, and finally dried in drying zone 10.

In diagram (c) of Fig. 2, a sheet-like body 12 to be coated is conveyed by a belt 11. A first coating film layer is formed on the surface of the body to be coated by a supply opening 4, and partially dried as necessary in drying zone 9. A second coating film layer is formed on the surface of the first layer, and finally dried in drying zone 10.

According to the present invention, it is sufficient that all the coating film layers are finally fully dried after the last coating film layer has been formed, and therefore a multilayer coating film can be formed by extremely compact equipment.

As the coating compositions which may be used according to the present invention, selection can be made from a large variety of coating compositions without regard to whether the composition is of the aqueous solution type or the non-aqueous solution type, so long as it can be atomized.

As examples of aqueous coating compositions (compositions comprising an aqueous carrier), there may be mentioned a coating composition prepared in such a manner that a resin such as a copolymer of acrylic ester and an acrylic acid or a methacrylic acid as described in JP-B-61-28986; a copolymer of styrene, acrylic ester, an acrylic acid or a methacrylic acid; a copolymer of acrylic ester, styrene, acrylonitrile or the like and an acrylic acid, a methacrylic acid, a maleic acid, an itaconic acid, or the like; a vinyl group polymer such as polyvinyl alcohol, polyvinyl acetate, polyvinyl pyrrolidone, or the like; etc., and the selected resin is dissolved or dispersed in water by any conventional well-known method.

As examples of the coating composition of the non-aqueous solution type (i.e., comprising an organic solvent), there may be mentioned a coating composition in which various kinds of resin is dissolved or dispersed in an organic solvent in the same manner as in the above case. For example, there is a solution in which resin such as a vinyl-chloride/vinyl-acetate group copolymer, acetal group resin, vinyl chloride/acetate group resin, urethane resin, acrylo-

nitrile butadiene resin, or the like is dissolved in an ester group containing a solvent such as methyl acetate, ethyl acetate, butyl acetate, ethyl lactate, or the like; a ketone group containing a solvent such as acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, or the like; n- or iso-butanol; xylol; or the like.

As other resins, there may be mentioned natural resins such as shellac, rosin, or the like; novolac phenol resins such as phenol formaldehyde resin, m-cresol formaldehyde resin or the like; a single polymer of an unsaturated carboxylic acid such as a polyacrylic acid, polymethacrylic acid, methacrylic acid-styrene copolymer, a methacrylic acid-methyl acrylate copolymer, a styrene-maleic anhydride copolymer, and the like, or a copolymer of the single copolymer and another monomer which can be copolymerized with the single copolymer; resin prepared in such a manner that a partial or perfect saponification material of polyvinyl acetate is partially acetalized by aldehyde such as acetaldehyde, benzaldehyde, hydroxybenzaldehyde, carboxybenzaldehyde, or the like; polyhydroxystyrene; and the like. Further, there are organic solvent soluble resins such as those having a cellulose alkyl ether group such as cellulose methyl ether, cellulose ethyl ether, and the like.

Moreover, the coating composition can be prepared by dissolving or dispersing one kind or more of the foregoing resin into a solvent comprising a single solvent or a mixture of two or more of, e.g., water; alcohol such as methanol, ethanol, or the like; ethylene glycol monomethyl ether; ethylene glycol monomethyl ether acetate; dimethylformamide; diethylformamide; dichloroethane; methyl ethyl ketone; cyclohexanone; toluene; or the like or into a solvent prepared by combining two or more of the foregoing solvents with each other.

As the body to be coated, there may be mentioned, for example, a sheet or plate-like body. Examples of the material of the body to be coated include paper laminated with a plastic material such as polyethylene, polypropylene, polystyrene, or the like which is fused by heat; a metal plate comprised of aluminum, various aluminium alloys, zinc, iron, copper, or the like; a plastic film such as cellulose diacetate, cellulose butyrate, cellulose acetate butyrate, cellulose propionate, cellulose triacetate, cellulose nitrite, polyethylene terephthalate, polypropylene, polycarbonate, polyvinyl acetal, or the like; paper or a plastic film covered with metal as described above by lamination or evaporation, and the like.

As the photosensitive compositions which may be used according to the present invention, compositions composed of diazo resin, o-quinonediazide compound, or the like are included.

The typical diazo resin is a condensation product of pdiazodiphenylamine and paraformaldehyde. The particularly preferable diazo compound is a salt of condensation product of pdiazophenylamine and formaldehyde or acetaldehyde, which includes, for example, a salt of phenol, fluorocapric acid or sulfonic acid such as triisopropylnaphthalenesulfonic acid, 4,4biphenyldisulfonic acid, 5-nitroortho-toluenesulfonic acid, 5sulfosalicylic acid, 2,5-dimethylbenzenesulfonic acid, 2nitrobenzenesulfonic acid, 3-chlorobenzenesulfonic acid, 3bromobenzenesulfonic acid, 2-chloro-5-nitrobenzenesulfonic acid, 2-fluorocaprylicnaphthalenesulfonic acid, 1-naphthol-5-sulfonic acid, 2-methoxy-4-hydroxy-5-benzolbenzenesulfonic acid, paratoluenesulfonic acid, or the like. The particularly preferable diazo compound is a compound having two or more diazo groups in one molecule thereof. As the other preferable diazo resin, a condensation product of 2,5-dimethoxy-4-ptolylmercaptonbenzenediazonium and formaldehyde, and a condensation product of 2,5-dimethoxy-4morpholinobenzenediazonium and formaldehyde or acetaldehyde are included, each of the condensation products including the salt mentioned above.

The diazo resin disclosed in GB-A-1,312,925 is also preferable.

The diazo resin can be individually used as a photosensitive material for forming the resist, but, preferably, the diazo resin is used with the binder.

Additionally, additives such as the phosphoric acid, the dye, the pigment, which are disclosed in US-A-3,236,646 can be added into the composite composed of the diazo resin.

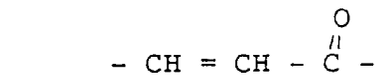
The particularly preferable o-quinonediazide compound is onaphthoquinonediazide compound, which is disclosed, for example, in US-A- 2,766,118, 2,767,092, 2,772,972, 2,859,112, 2,907,665, 3,046,110, 3,046,111, 3,046,115, 3,046,118, 3,046,119, 3,046,120, 3,046,121, 3,046,122, 3,046,123, 3,061,430, 3,102,809, 3,106,465, 3,635,709, 3,647,443, and so on. The disclosed compound can be suitably and preferably used according to the present invention. Particularly, o-naphthoquinonediazidesulfonic acid ester or onaphthoquinonediazidecarboxylic acid ester, which are of the aromatic hydroxy compound, and o-naphthoquinonediazidesulfonic acide amide or o-naphthoquinonediazidecarboxylicamide, which are of the aromatic amino compound, are preferred. More particularly, the compound formed by the esterification of onaphtholquinonediazidesulfonic acide with a condensation product of pyrogallol and acetone as disclosed in US-A-3,635,709, the compound formed by the estification of o-naphthoquinonediazidesulfonic acid or onaphthoquinonediazidecarboxylic acid with polyester having hydroxy group as its end group as disclosed in US-A-4,028,111, or the compound formed by the estification of o-naphthoquinonediazidesulfonic acid or onaphthoquinonediazidecarboxylic acid with homopolymer of p-hydroxystyrene or copolymer of p-hydroxystyrene and monomer which can attain copolymerization therewith.

The o-quinonediazide compound noted above can be individually used, but, preferably, the o-quinonediazide compound is used with being mixed with the alkali soluble resin. As the preferable alkali suluble resin, the novolak type penol resin is included, and, more perticularly, phenolformaldehyde resin, ocresolformaldehyde resin, m-cresolformal-

dehyde resin, or the like is included. Further, as disclosed in US-A-4,123,279, it is more preferable that the phenol resin noted above is used together with the compound of formaldehyde and phenol or cresol substituted by the alkyl group in which the number of carbon is from three to eight, such as tbutylphenolformaldehyde resin. The alkali soluble resin is contained in the photosensitive and resist formable composite at 50 to 85 weight %, more preferably, at 60 to 80 weight %, if the entire weight of the photosensitive and resist formable composite is set as a reference.

The pigment, the dye, the plasticizer, or the like can be included in the photosensitive composite composed of the o-quinonediazide compound as the need arises.

In addition, the composite composed of the photosensitive azide compound, the composite composed of macromolecular compound having a



group at its main chain or side chain of the polymer, and the photopolymerization composite composed of the addition polymerizable unsaturated compound can be used according to the present invention.

In order to further clarify the operation and effects of the present invention, examples will be described hereunder.

Example 1

In the apparatus of Fig. 2 (b), coating compositions having the composition and physical property shown in Table 1 was applied from the first and second supply openings (4b and 4c) onto an aluminum film which was running at a speed of 60 m/min and having a width of 1000 mm and a thickness of 0.1 mm. In this case, the opening 4a and the drying zone 8 are not used. The quantity of application of the coating composition from each of the supply openings was 12 ml/m^2. The solvent of lower layer coating composition was evaporated at 50°C for a very short time of about 5 s in drying zone 9. Then, the thus obtained coating film which was still wet was further coated by supply opening 4c, and dried at 100 °C for 20 s in drying zone 10 to thereby form a dried film. As a result, a film was produced in a short time and having coated thereon multilayers having good separation between the layers and having an exterior which was very smooth.

Table 1

Composition of upper layer coating composition:	
cresol resin	7 weight portion (including chlorine)
cellosolve acetate	40 weight portion
methyl ethyl ketone	8 weight portion
fluorine-group surface active agent	0.02 weight portion
Composition of lower layer coating composition:	
phenol resin	8 weight portion
cellosolve acetate	40 weight portion
methyl ethyl ketone	8 weight portion

Comparative Example 1

The same body as in Example 1 was coated with the composition of Table 1 by using an extrusion coater 18 in the apparatus of Fig. 2(d), and then dried at 100°C for 30 s. Mottles already appeared on the film surface immediately after the coating, and after drying, the film surface was further disturbed.

The amount of chlorine in the cresol resin of the upper layer of each of the foregoing coating films was analyzed by using an electron spectroscopy for chemical analysis (ESCA) while polishing the film. Figure 6 is a graph in which the data derived from Example 1 and Comparative Example 1 was plotted. In Fig. 6, solid and a dotted lines represent measurement results of samples obtained from Example 1 and Comparative Example 1, respectively.

As can be seen from Fig. 6, in Comparative Example 1, diffusion/mixing was caused in the various layers of the coating composition in the time between coating and drying, and significant interlayer mixing occurred. In Example 1, on the contrary, it is found that only a little mixing was caused so that the layers were separated from each other. This directly resulted from the process by which the layers of Example 1 were coated.

By the process for producing a multilayer structure according to the present invention, it has been made possible to produce high-quality photosensitive printing plates with no interlayer mixing. Further, since multilayer coating can be successively continuously performed, the equipment can be made more compact and inexpensive, and since productivity can be improved, it has been made possible to realize reduction of the cost of production.

Claims

1. A process for forming a multilayer structure on a photosensitive printing plate, said process comprising the steps of:

   (a) atomizing a first coating composition;
   (b) passing said first coating composition with a carrier gas through a transport tube to a supply nozzle such that those particles of the first coating composition having a diameter of more than 50 μm are eliminated before they reach the supply nozzle;
   (c) electrostatically charging the first coating composition having a viscosity of from 0.005 to 0.1 Pa·s (5 cp to 100 cp);
   (d) electrostatically adhering the first coating composition on a moving support to form a first coating layer thereon;
   (e) partially drying the first coating layer so that the viscosity of the first coating layer is 0.1 Pa·s (100 cp) or more; and
   (f) repeating steps (a) through (d) to form a second coating layer on the surface of said first coating layer.

2. The process of claim 1, further comprising

   (g) running said first and second coating layers, formed on said moving support, through a final drying zone to fully dry said multilayer structure.

3. The process of claim 1, further comprising

   (g) partially drying the second coating layer so that the viscosity of the second coating layer is 0.1 Pa·s (100 cp) or more;
   (e) repeating steps (a) through (d) for a third coating composition to form a third coating layer on the upper surface of said second coating layer; and
   (f) running said first, second and third coating layers, formed on said moving support, through a final drying zone to fully dry said multilayer structure.

4. The process of claim 1, wherein said first and second coating layers are photosensitive.

Patentansprüche

1. Verfahren zur Bildung einer Mehrschichtenstruktur auf einer lichtempfindlichen Druckplatte, wobei das Verfahren die Stufen umfaßt:

   (a) Zerstäuben einer ersten Beschichtungszusammensetzung;

   (b) Durchleiten der ersten Beschichtungszusammensetzung mit einem Trägergas durch ein Transportrohr zu einer Zuführungsmündung, in der Weise, daß diejenigen Partikel der ersten Beschichtungszusammensetzung, die einen Durchmesser von mehr als 50 μm haben, entfernt werden, ehe sie die Zuführungsmündung erreichen;

   (c) elektrostatisches Aufladen der ersten Beschichtungszusammensetzung einer Viskosität von 0,005 bis 0,1 Pa·s (5 cp bis 100 cp);

   (d) elektrostatisches Anhaften der ersten Beschichtungszusammensetzung auf einen bewegten Träger zur Bildung einer ersten aufgetragenen Schicht darauf;

   (e) teilweises Trocknen der ersten aufgetragenen Schicht, so daß die Viskosität der ersten aufgetragenen

Schicht 0,1 Pa·s (100 cp) oder mehr beträgt; und

(f) Wiederholen der Stufen (a) bis (d) zur Bildung einer zweiten aufgetragenen Schicht auf der Oberfläche der ersten aufgetragenen Schicht.

2. Verfahren des Anspruchs 1, weiter umfassend

(g) Durchlaufen der auf dem bewegten Träger gebildeten ersten und zweiten aufgetragenen Schicht durch eine Endtrocknungszone zur vollständigen Trocknung der Mehrschichtenstruktur.

3. Verfahren des Anspruchs 1, weiter umfassend

(g) teilweises Trocknen der zweiten aufgetragenen Schicht, so daß die Viskosität der zweiten aufgetragenen Schicht 0,1 Pa·s (100 cp) oder mehr beträgt;

(f) Wiederholen der Stufen (a) bis (d) für eine dritte Beschichtungszusammensetzung zur Bildung einer dritten aufgetragenen Schicht auf der oberen Oberfläche der zweiten aufgetragenen Schicht; und

(g) Durchlaufen der auf dem bewegten Träger gebildeten ersten, zweiten und dritten aufgetragenen Schicht durch eine Endtrocknungszone zur vollständigen Trocknung der Mehrschichtenstruktur.

4. Verfahren des Anspruchs 1, bei dem die erste und zweite aufgetragene Schicht lichtempfindlich sind.

Revendications

1. Procédé pour la formation d'une structure multicouche sur une plaque d'impression photosensible, ledit procédé comprenant les étapes consistant :

(a) à atomiser une première composition de revêtement;
(b) à faire passer ladite première composition de revêtement avec un gaz porteur à travers un tube de transport vers une buse d'alimentation de telle sorte que les particules de la première composition de revêtement présentant un diamètre supérieur à 50 µm sont éliminées avant qu'elles n'atteignent la buse d'alimentation;
(c) à charger électrostatiquement la première composition de revêtement présentant une viscosité de 0,005 à 0,1 Pa.s (5 cp à 100 cp);
(d) à coller électrostatiquement la première composition de revêtement sur un support en déplacement pour former une première couche de revêtement sur son dessus;
(e) à sécher partiellement la première couche de revêtement de telle sorte que la viscosité de la première couche de revêtement est de 0,1 Pa.s (100 cp) ou supérieure; et
(f) à répéter les étapes (a) à (d) pour former une seconde couche de revêtement sur la surface de ladite première couche de revêtement.

2. Procédé selon la revendication 1, comprenant en outre l'étape consistant

(g) à faire passer lesdites première et seconde couches de revêtement, formées sur ledit support en déplacement, à travers une zone de séchage final pour sécher complètement ladite structure multicouche.

3. Procédé selon la revendication 1, comprenant en outre les étapes consistant

(g) à sécher partiellement la seconde couche de revêtement de telle sorte que la viscosité de la seconde couche de revêtement est de 0,1 Pa·s (100 cp) ou supérieure,
(e) à répéter les étapes (a) à (d) pour une troisième composition de revêtement pour former une troisième couche de revêtement sur la surface de dessus de ladite seconde couche de revêtement; et
(f) à faire passer lesdites première, seconde et troisième couches de revêtement, formées sur ledit support en déplacement, à travers une zone de séchage final pour sécher complètement ladite structure multicouche.

4. Procédé selon la revendication 1, dans lequel lesdites première et seconde couches de revêtement sont photosensibles.

FIG. 1

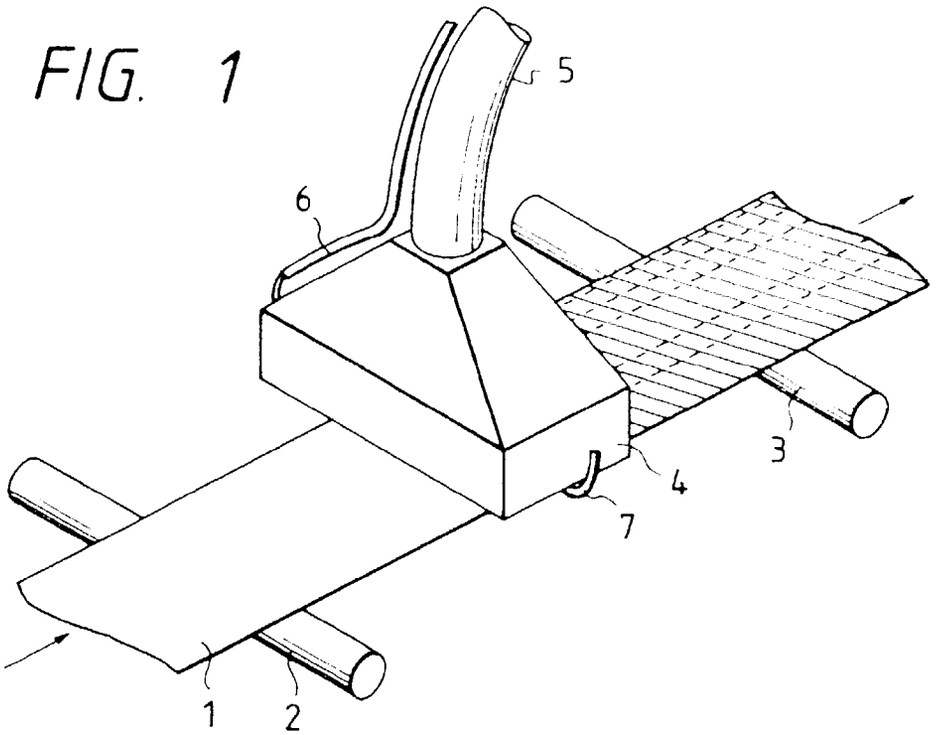


FIG. 3(a)



FIG. 3(b)

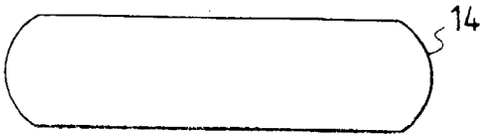


FIG. 3(c)

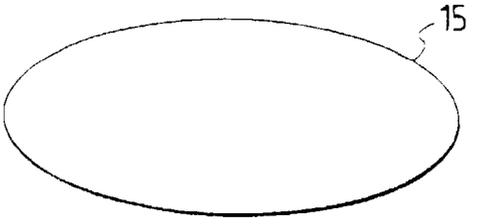


FIG. 2(a)

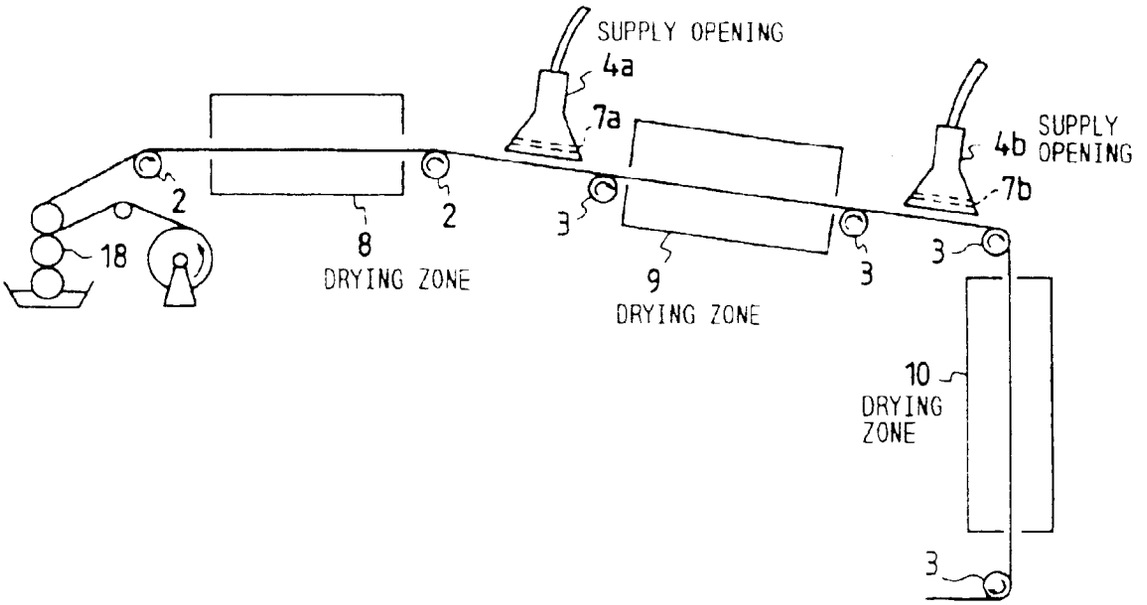

SUPPLY OPENING
4a
7a
4b
SUPPLY OPENING
7b
2
18
8
DRYING ZONE
2
3
9
DRYING ZONE
3
3
10
DRYING ZONE
3

FIG. 2(b)

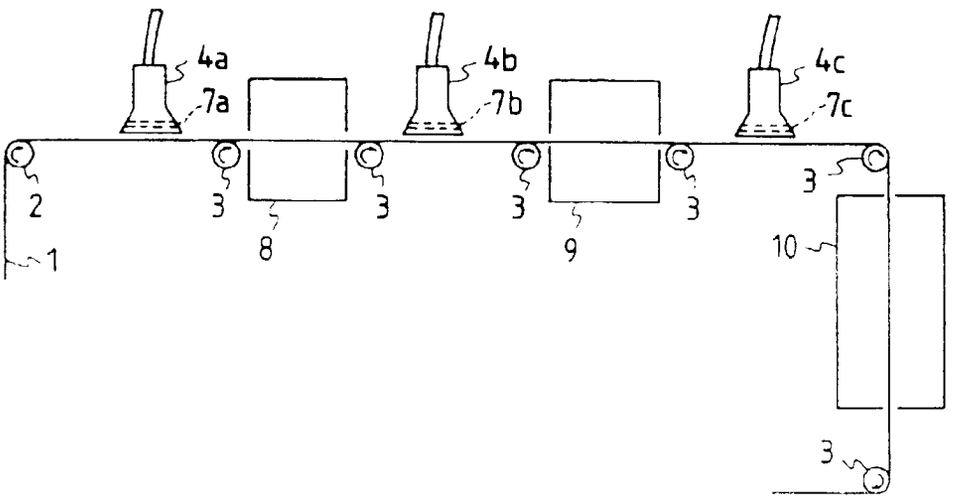

4a
7a
4b
7b
4c
7c
2
1
3
8
3
3
9
3
3
10
3

FIG. 2(c)

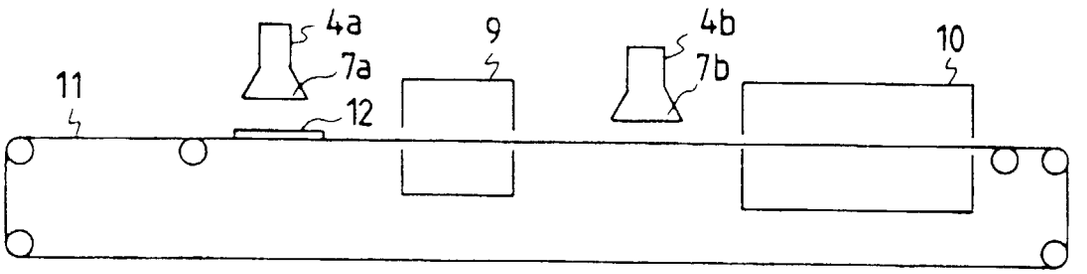


FIG. 2(d)

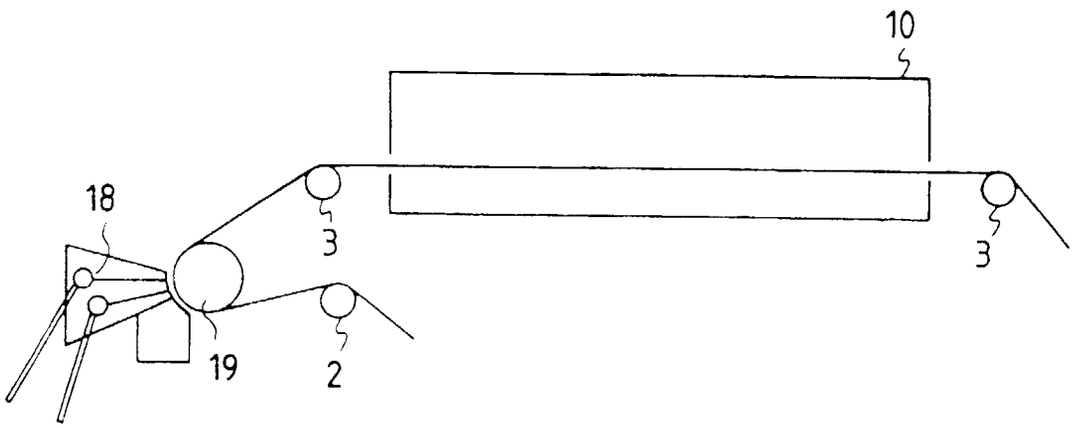


FIG. 4

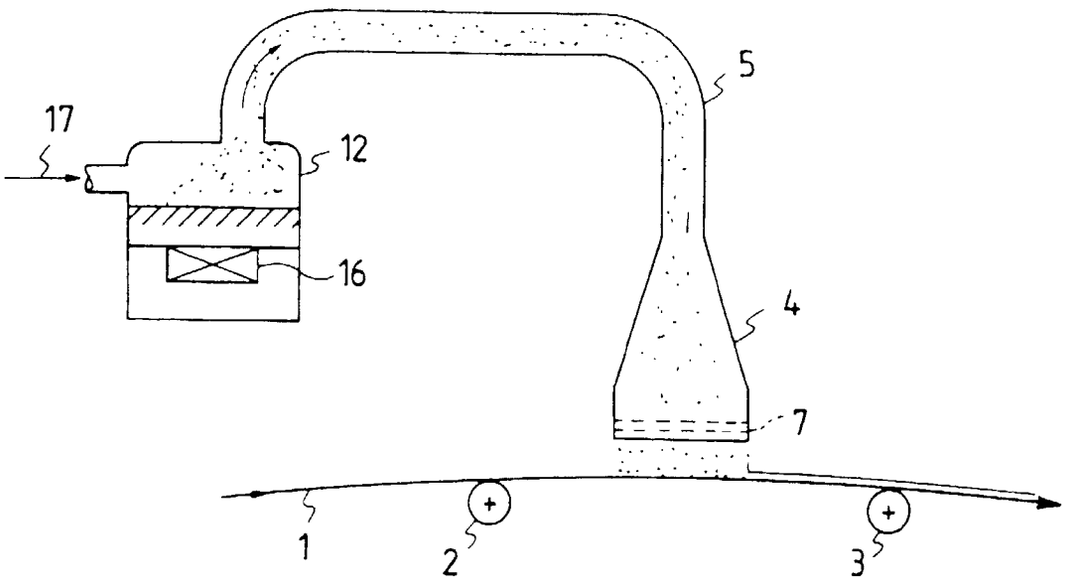


FIG. 5

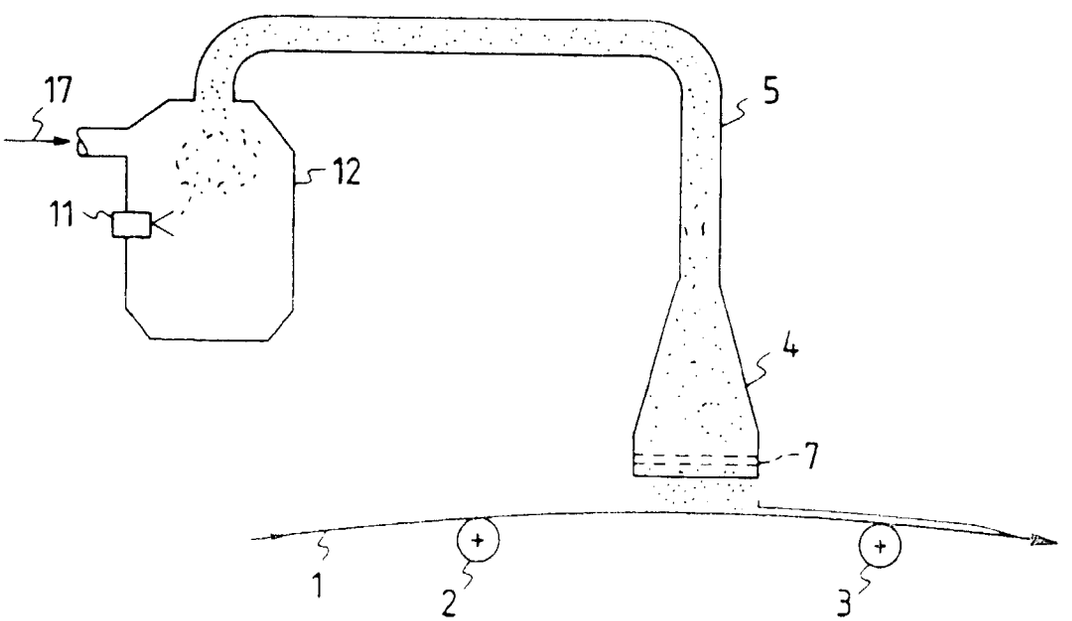
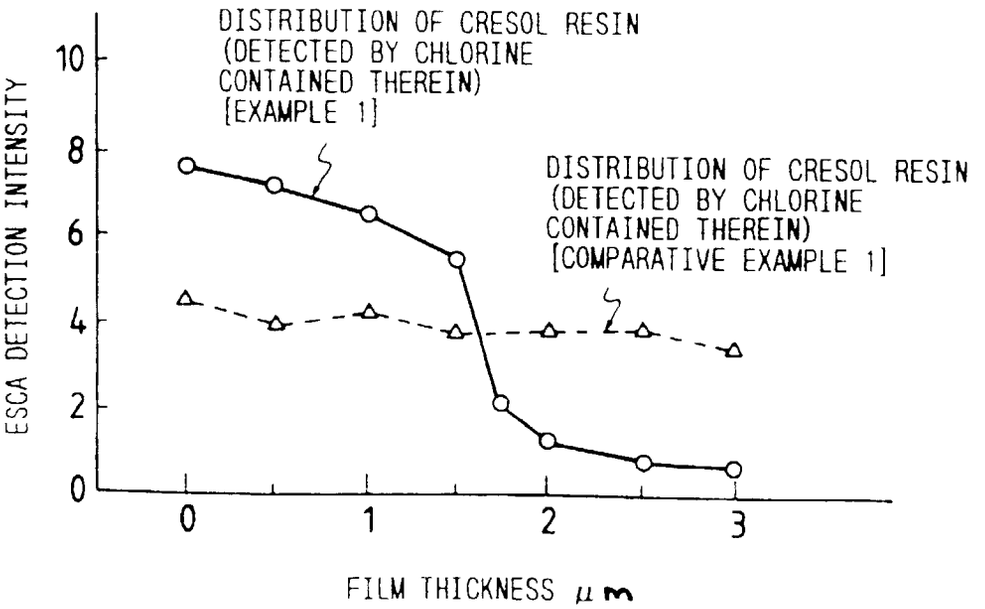


FIG. 6


DISTRIBUTION OF CRESOL RESIN
(DETECTED BY CHLORINE
CONTAINED THEREIN)
[EXAMPLE 1]
DISTRIBUTION OF CRESOL RESIN
(DETECTED BY CHLORINE
CONTAINED THEREIN)
[COMPARATIVE EXAMPLE 1]
ESCA DETECTION INTENSITY
10
8
6
4
2
0
0
1
2
3
FILM THICKNESS μm